

# Introducing the CT GIS Office and New Imagery Services

Alfredo Herrera, GIO, CT GIS Office

Carl Zimmerman, PhD, CT GIS Office

Emily Wilson, UCONN CLEAR, Geospatial Educator

Sept 12, 2024

*Presented as a webinar in collaboration with UCONN CLEAR*



**CONNECTICUT**  
Policy and Management

# Overview

## 2 parts

- Introducing the CT GIS Office
- All about Imagery Services
  - What are web services?
  - Finding imagery and using it
  - Available tools

### Introducing the CT GIS Office and Accessing Mapping Data for Connecticut

Date & Time Sep 12, 2024 01:00 PM in [Eastern Time \(US and Canada\)](#)

Description September 12, 2024, 1-2 PM EDT  
Hosts: UConn CLEAR  
Speakers: Alfredo Herrera, Geographic Information Officer, Carl Zimmerman, GIS Coordinator, CT GIS Office, CT OPM & Emily Wilson, UConn CLEAR

After introducing the webinar series, the first part of this two-part webinar will be about the role of the CT GIS Office (GISO), how it was formed and functions, what services and guidance it provides, and how it works with partners across the state. Specifically, the CT GIS Office coordinates geospatial data acquisition and creation, provides standards and training, and supports analytic capabilities for GIS users.

The second part of the webinar will be a technical discussion about image services and describe how they are different from map and features services. We will describe how to find and connect to them, what functions are available, and how online and desktop GIS software (ArcGIS Pro and QGIS) handles them. The focus will be on the soon-to-be-released 2023 statewide aerial imagery.

# GIS Office & Geographic Information Officer (GIO)

OPM's Geographic Information Systems (GIS) Office was established in 2022 following passage of Public Act 21-2 during the 2021 June Special Session.

It is directed by a Geographic Information Officer (GIO) and resides within the Data and Policy Analytics Unit of OPM.

# GIS Office Responsibilities

*CGS Sec. 4d-90-92, 16-330b (Broadband)*

- **GIS data coordination.** Coordinating the collection, compilation and dissemination of GIS data across the state, including from and to state agencies, regional councils of governments, municipalities and other constituencies;
- **Open data.** Managing a publicly accessible geospatial data clearinghouse;
- **Supporting economic development.** Using GIS to support economic development efforts in the state;
- **Outreach & training.** Provide training and outreach on the use of GIS;
- **Orthoimagery.** Administering a statewide orthoimagery and lidar program;
- **Guidance & Standards.** Adopting geospatial data standards, guidelines, and procedures;
- **Data processing.** Performing technical data processing to aggregate and organize existing datasets and create new datasets; and
- **Broadband mapping.** Develop broadband data and mapping in accordance with Public Act 21-159.

# GIS Office Staff

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## CT GIS Office

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Alfredo Herrera – Geographic Information  
Officer

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Carl Zimmerman – GIS Coordinator

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Ashley Benitez – GIS Coordinator

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Leah Hodges – GIS Analyst

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Sarah Hurley – GIS Analyst

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# Data Opportunities



CT Geodata Portal

About

Data Library

Partners

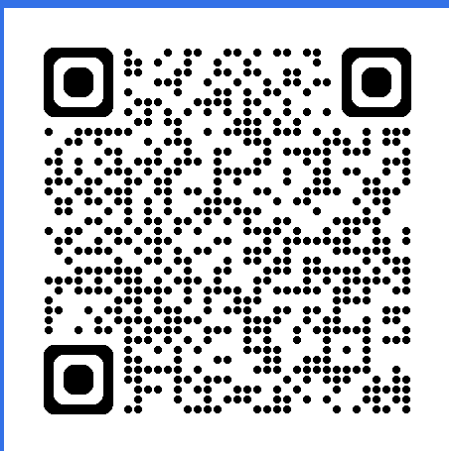
# CT Geodata Portal

Search or browse GIS data for Connecticut

[New & Noteworthy](#) | [CT at a Glance](#) | [Data Categories](#) | [Partners](#)

# Geodata Portal Highlights

<https://geodata.ct.gov>



ArcGIS Hub based GIS Clearinghouse built in collaboration with Esri.

The Geodata Portal shares partner agency data to make it available all in one place.

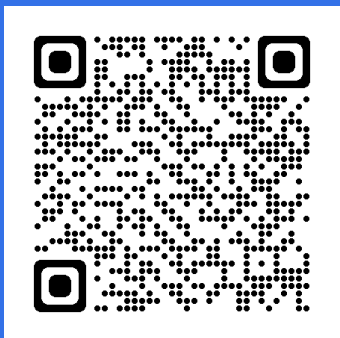
The site has been live for almost 2 years!  
Updates occur regularly.

Coordinating with state agencies to regularly add new data.

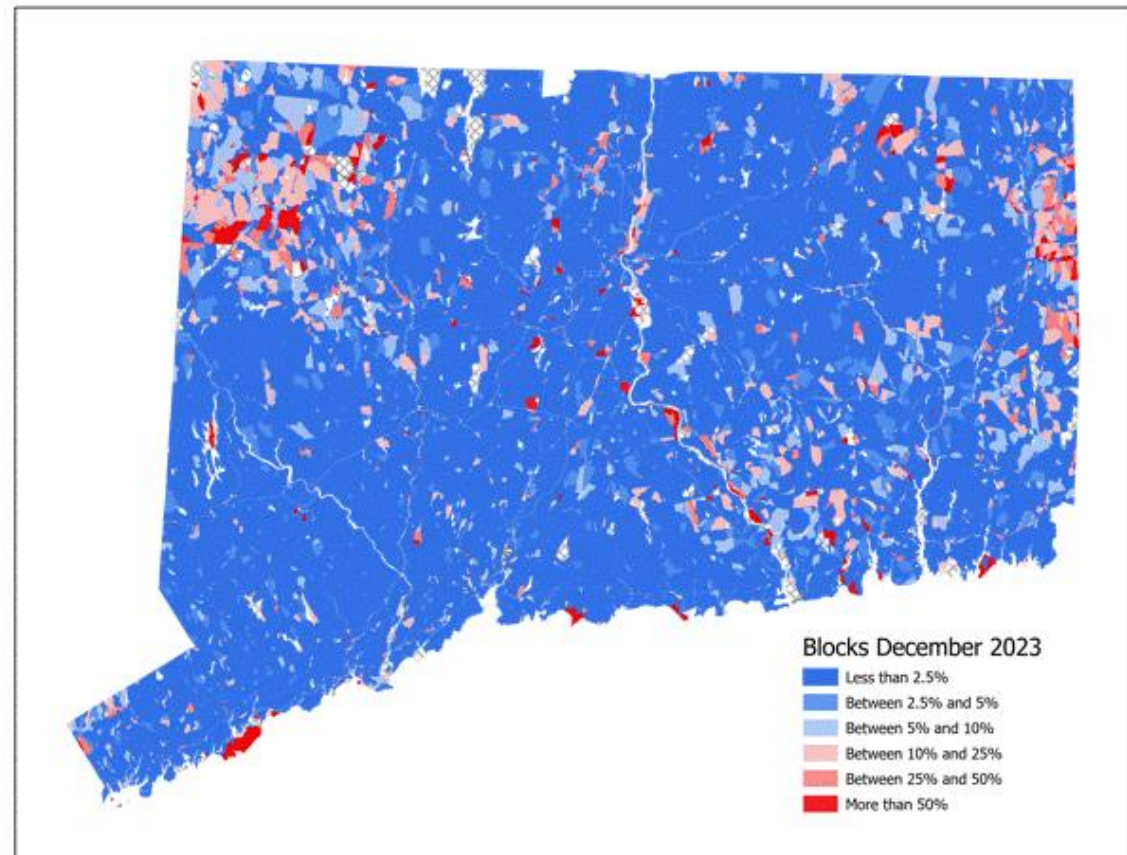


# Broadband Mapping

Visit [broadbandmaps.ct.gov](https://broadbandmaps.ct.gov) for more!

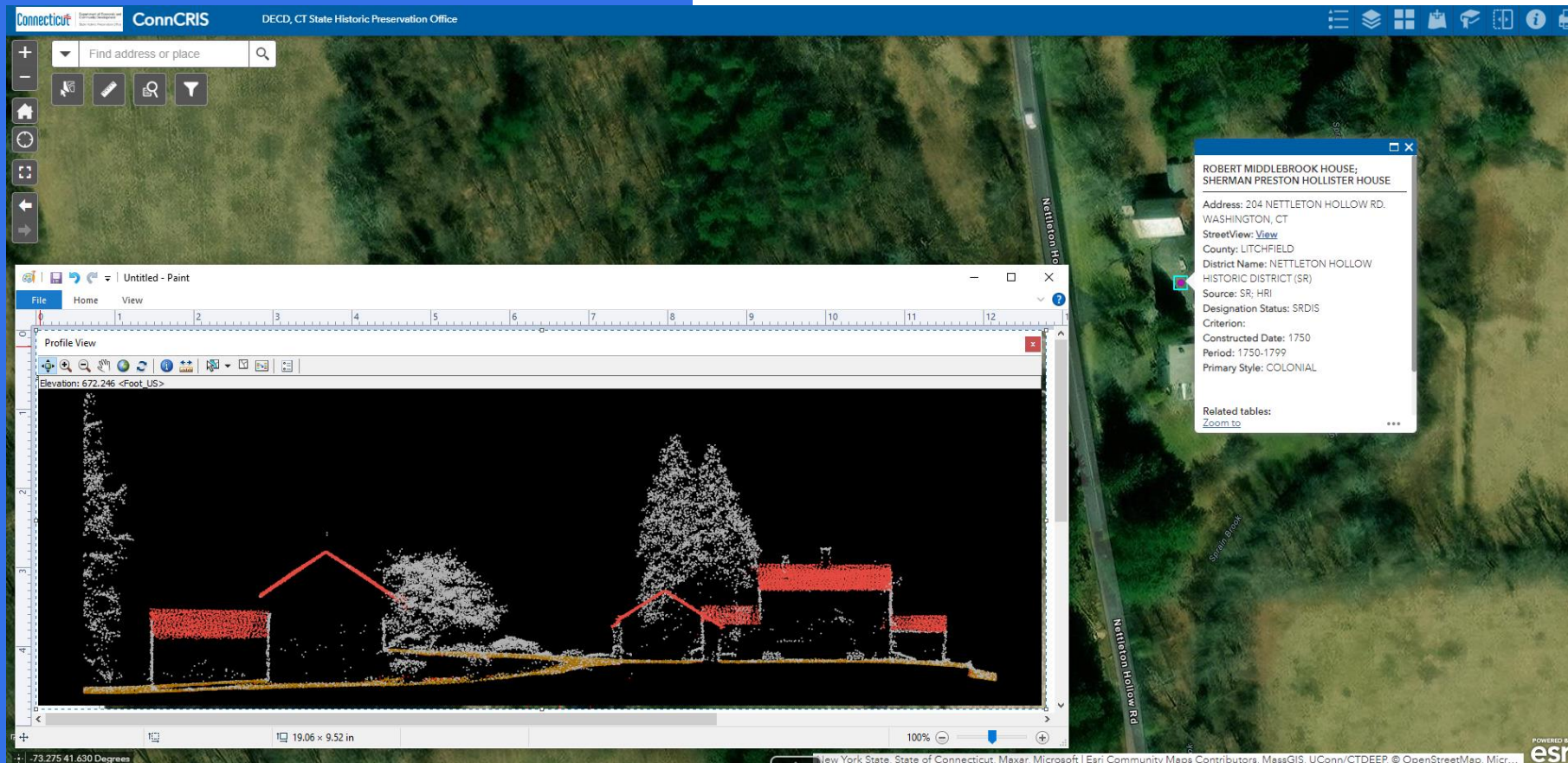


- Fifth data collection from ISPs underway to provide a timely and granular look at the state of broadband in CT.
- New public maps by Dec 1.

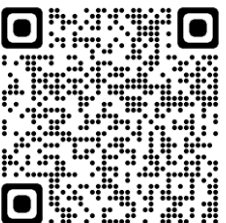


# ConnCRIS Application

- CT SHPO Launched the ConnCRIS Public Viewer.
  - Displays only above-ground cultural resources.
- New secure viewer available now!
  - Request access with SHPO.



Visit [conncris.ct.gov](http://conncris.ct.gov) for more!

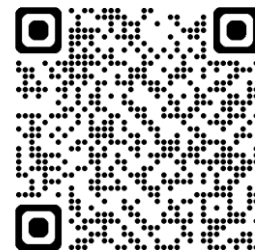


# Statewide Parcels

Seamless Statewide Dataset

Full attribution from assessors' databases

2024 update underway, new dataset expected this fall




<https://geodata.ct.gov/pages/parcels>



# Statewide Parcel Viewer

CONNECTICUT PARCEL VIEWER

CT GIS Office  
CT Geodata Portal



ABOUT THE PARCEL VIEWER

The Connecticut Parcel Viewer displays the most recent property and boundary data aggregated from towns and COGs across CT per the [Connecticut General Statute Section 7-100I](#). Read more about the parcel dataset [here](#).

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HOW TO USE THE PARCEL VIEWER

Click on a parcel to view a popup with information about the parcel.

To search for an address, click on the magnifying glass icon in the top left corner of the map.

To zoom to a town or COG, use the filter buttons above the map. Click the "Apply" button to zoom. Click the "Cancel" button to go back to the statewide view. When searching for a town in the dropdown, click the "Search more" button if the "No data" message appears.

To zoom in and out of the map,

Submit feedback about the Parcel Viewer


Select a COG: - All -
Select a town: - All -
Apply
Cancel

Q

Hartford

+  
-  
🏠

HARTFORD - 168 CAPITOL AVE

🔍 Zoom to

OBJECTID	1105562
Town Name	HARTFORD
Link	37070-224431013
Owner	STATE OF CONN CAPITOL
Co Owner	
Location	168 CAPITOL AVE
Mailing Address	210 CAPITOL AV
Mailing City	HARTFORD
Mailing State	CT
Assessed Total	52,253,390
Assessed Land	20,005,790
Assessed Building	32,180,680
Pre Year Assessed Total	52,253,390
Appraised Land	28,579,700

Esri Community Maps Contributors, City of Hartford, CT, MDC, MassGIS, UConn/CTDEEP, © OpenStreetMap, Microsoft, Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, US Census... Powered by Esri

# Statewide Addressing

GIS Office partnering with DESPP/DSET to further improve the Address Point dataset.

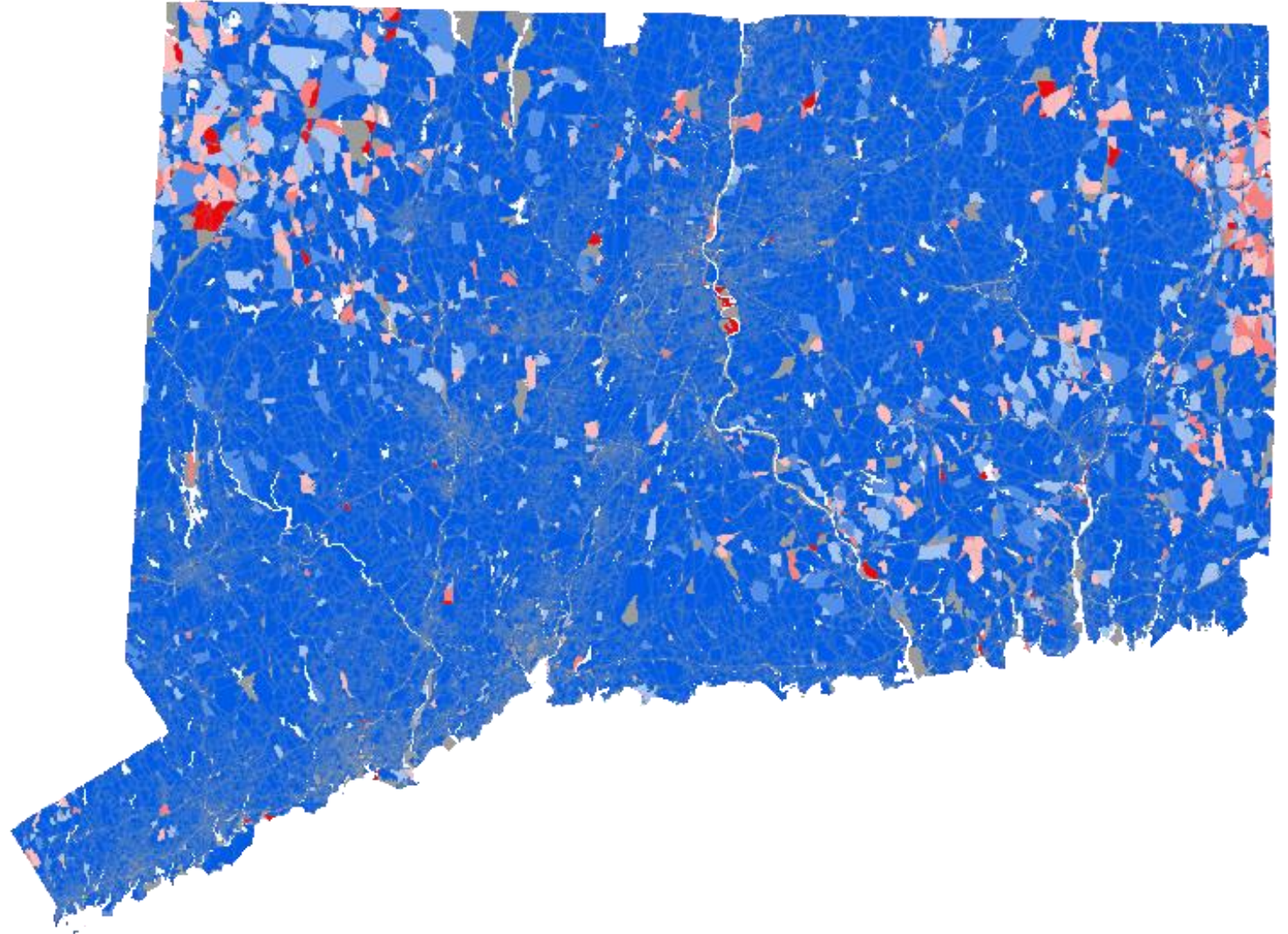
Currently aggregating data from utilities, ISPs, and other available sources to fill gaps in current dataset.

- DSET data has 1.1M addresses, GISO data has 1.5M addresses, and we estimate ~1.8M total addresses in CT.

Developing a plan to more easily collect address data from local authorities.

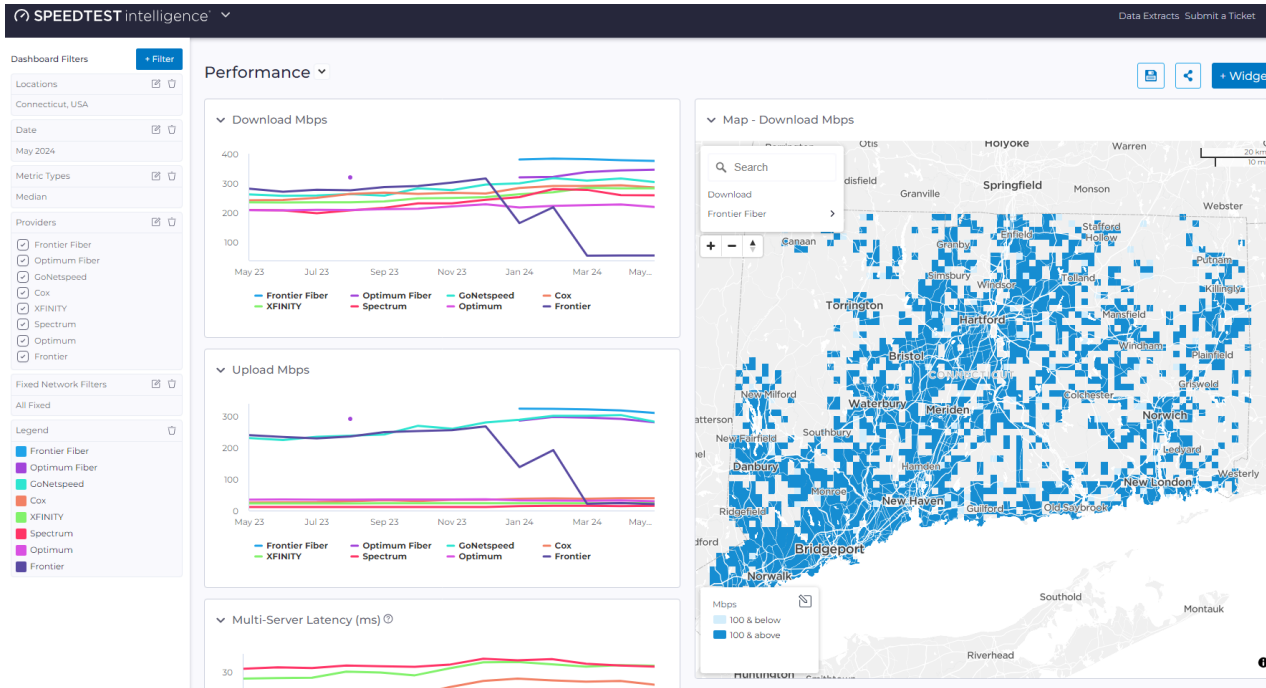
Collaborating with DSET and DOT to create a more accurate and publicly sharable centerline layer.

# Broadband Activities



<https://broadbandmaps.ct.gov/>

# Broadband



## 2024 CT's Broadband Data Collection – Starting Soon

- > ISPs have been contacted to reestablish the data collection process.
- > We are targeting simplified schemas that better align with FCC BDC Submissions.

## Ookla Speedtest Intelligence (STI) Portal and Data Extracts

### Includes:

- > Tests at 100x100 meter bins
- > Performance data, including Download, Upload, Latency, Consistency Score™, and Speed Score™.

## ArcGIS Living Atlas Data

[Federal Communications Commission Data – June 2023](#)

[Ookla Speedtest for Global Broadband Performance](#)

# Part 2: All about Imagery Services

What are web services?  
Finding imagery and using it  
Available tools





# The Aerial Imagery Data Acquisition Program

Two imagery and LiDAR captures in Spring 2023 and Spring 2026.

Dewberry selected as the vendor, aerial acquisition complete, QAQC complete, data deliveries now beginning.

Products purchased for both captures.\*

**3" 4-band imagery** (True ortho over urban cores and tall bridges)

**QL1HD LiDAR data** (20ppsm coastal, 15ppsm inland)

**2-foot DEM**

**1 ft. Contours**

**Building Footprints** (>100 ft<sup>2</sup>)

**3D Terrain and (LoD2) Building Models**



\* Additional dataset purchases in the exploratory phase.

# Specifications for Imagery

## ASPRS Specifications

- Authoritative geospatial standards

### RGB

- 3-inch pixels
- Leaf-off, low-tide, snow free, >35 degrees sun angle, distortion and smudge free

### Near IR

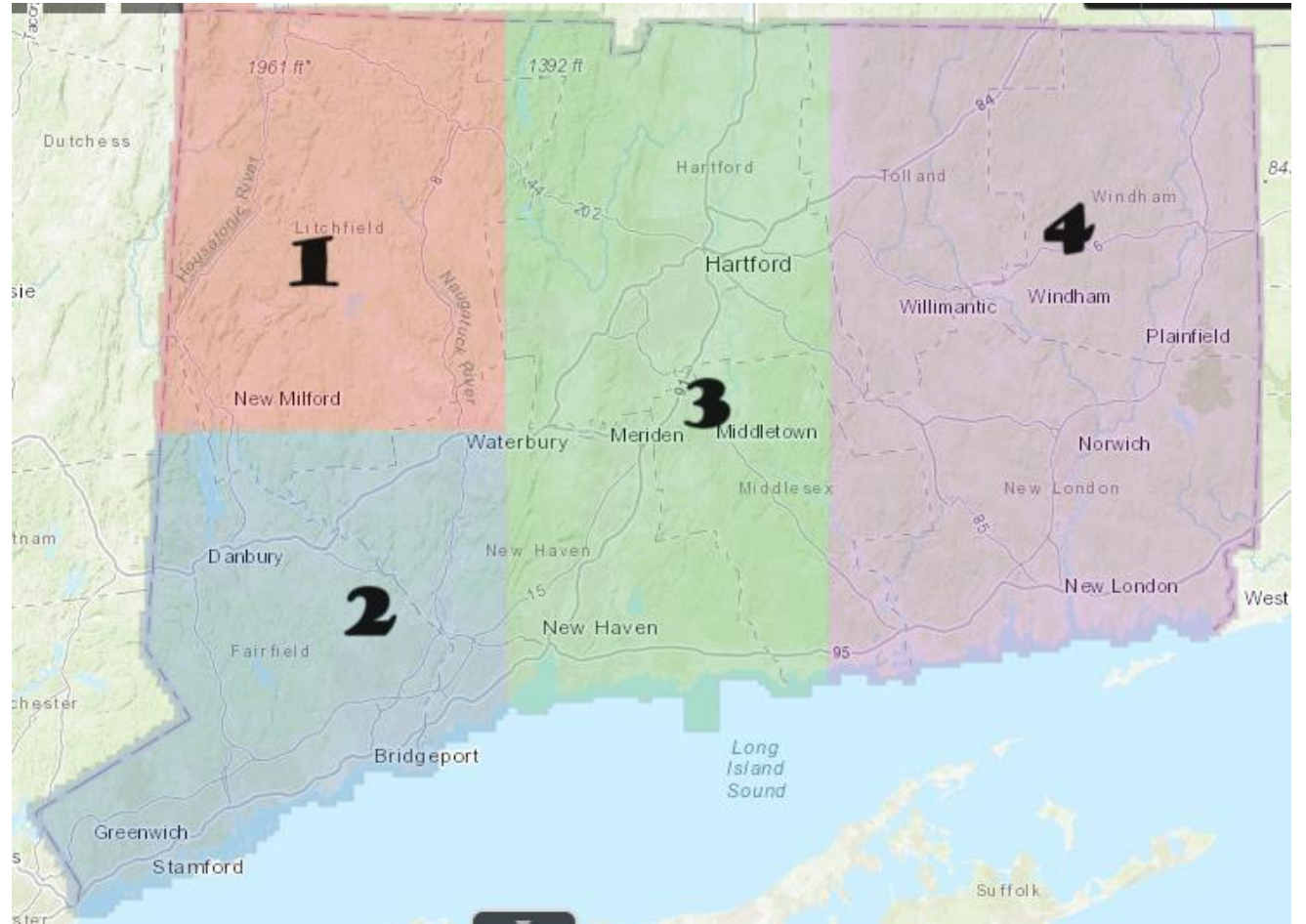
- Flown at same time
- Drop blue band and add invisible IR band through the red channel for visualization
- Useful for environmental applications and finding vegetation/h<sub>2</sub>O

### True Ortho

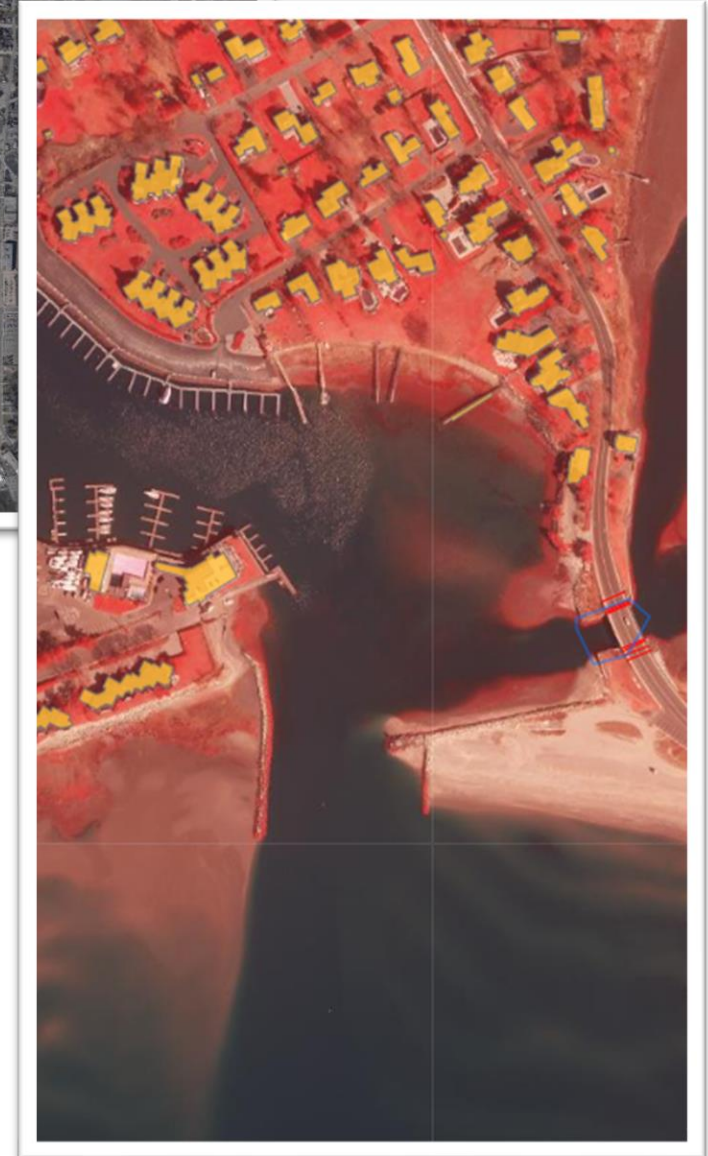
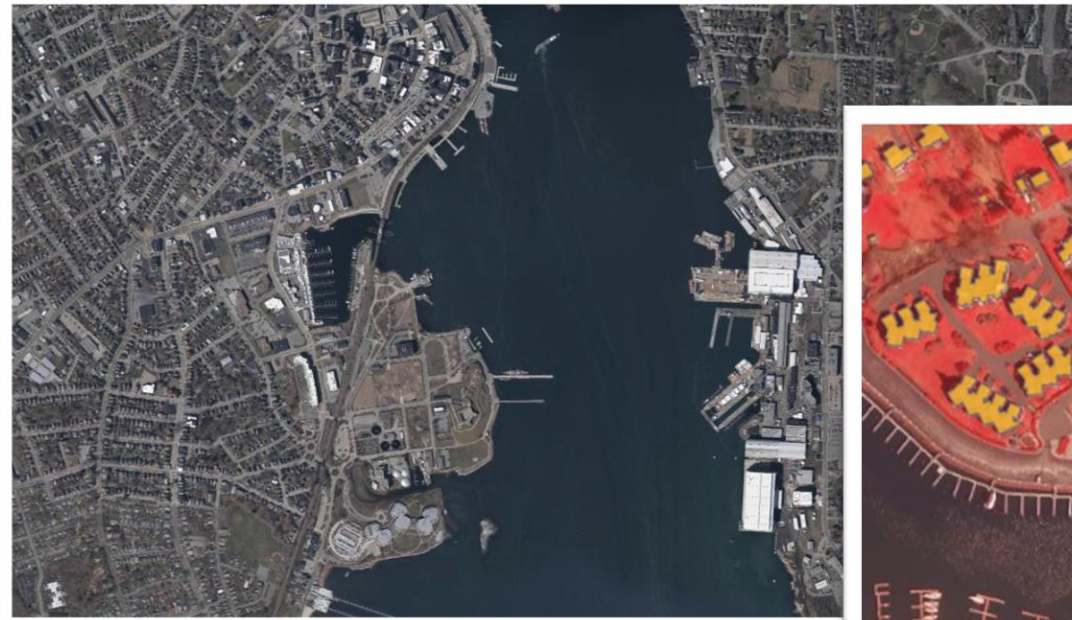
- Will be added to the imagery service

# Delivery Blocks and Schedule

Strategically arranged to have least amount of work in Block 1 and most amount of processing in Block 3.



# We have Imagery!



# True Ortho



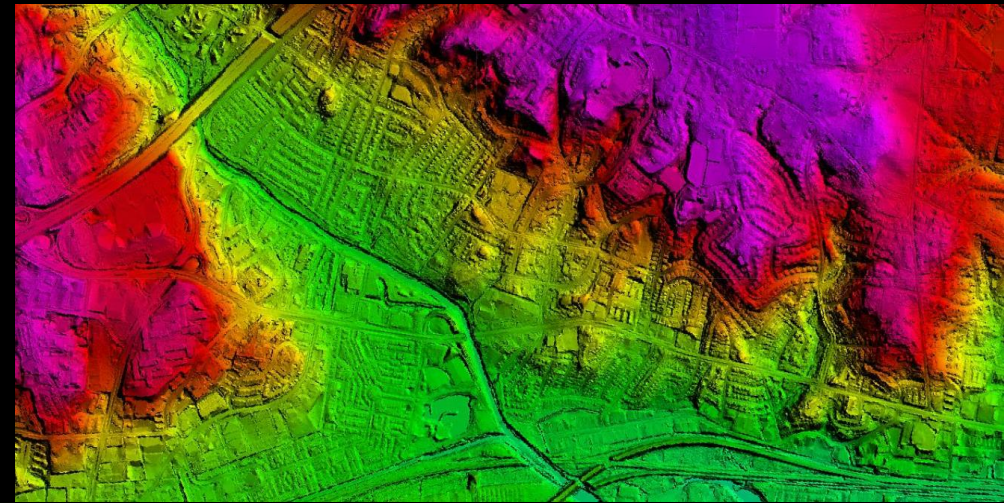
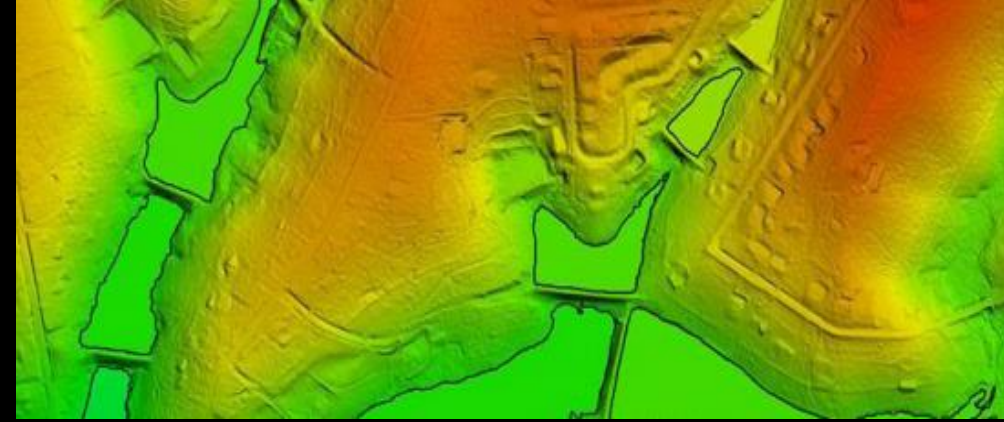
# DEM Products

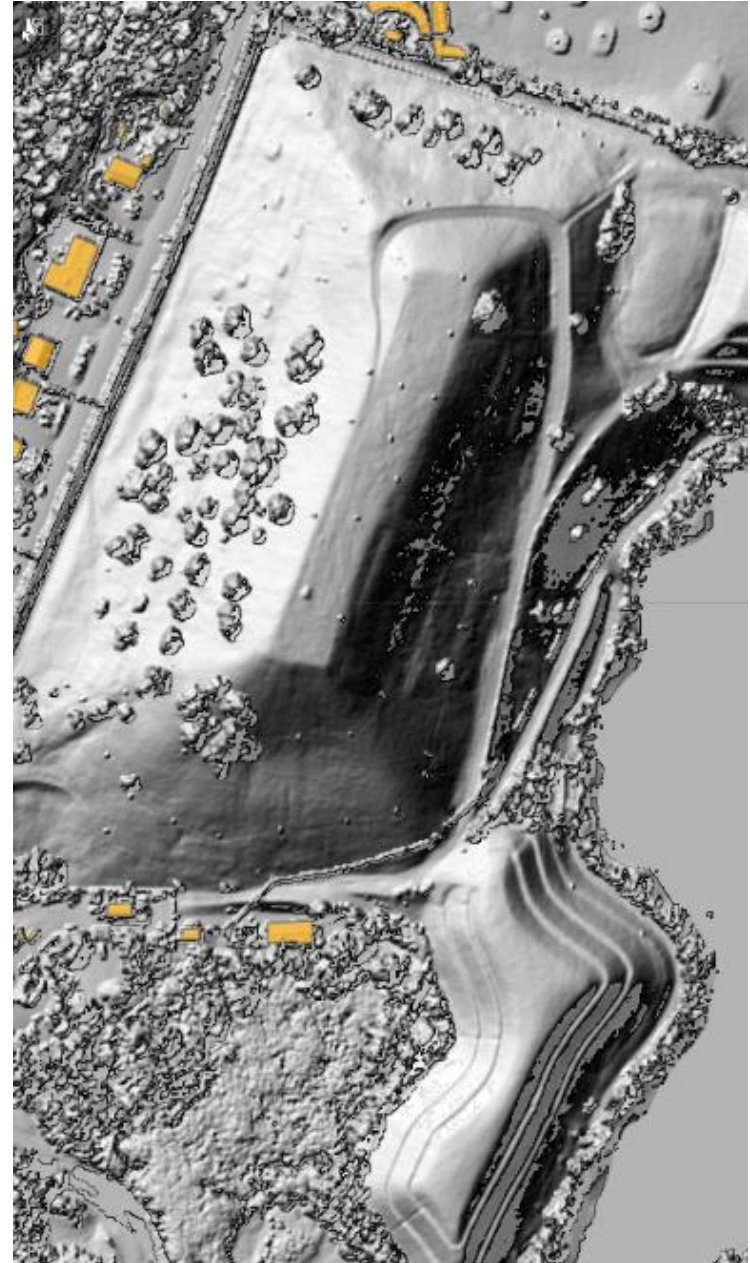
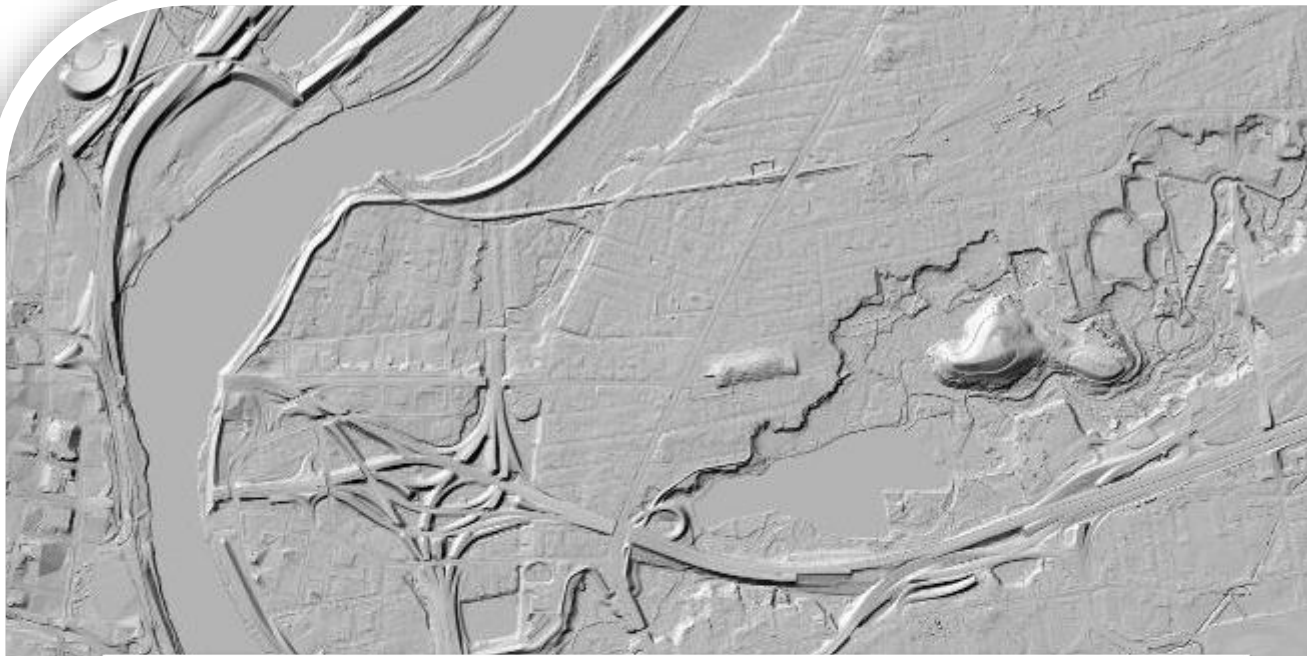
Breaklines

- ML/AI training and extraction of hydrographic features
- Manual review of 2D placement and completeness of capture
- Hydrographic features are conflated, enforce monotonicity for Rivers
- 3D QC is performed (Vertical Variance, Monotonicity, Topology)
- Bridge breaklines are collected where necessary, to flatten bridge saddles

Bare Earth DEM Generation

- Initial Bare Earth DEMs generated and reviewed, with QC focus on bare earth definition and hydro-flattened features
- Final Bare Earth DEM accuracy tested (NVA and VVA)
- All final products generated in required formats









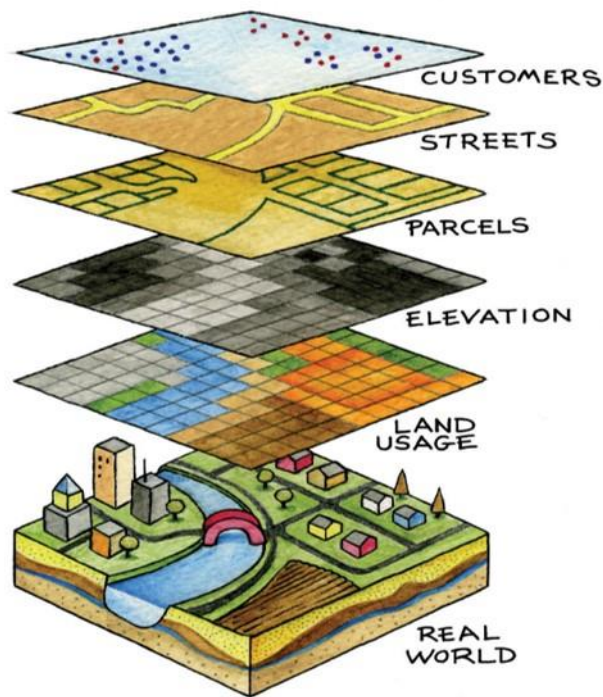
# Data volume: How do we deliver this data to you?

## The data is really BIG.

- 23k tiles over 4 blocks
- RGB and NIR (3")
  - 23k Imagery Tiles and 2.338 trillion pixels
  - 2 data sets & 7 bands
- Classified Lidar
  - 177 billion lidar points with 10+ classes
- DEM (raster, 2 ft)
  - 36.5 million elevation pixels
- Buildings
  - 1.9 million buildings
- Streams, rivers, coastline
  - 1000 +/- miles
- Ponds
  - 3700 ponds and lakes

# Different Geospatial Approaches

## GIS Desktop Model



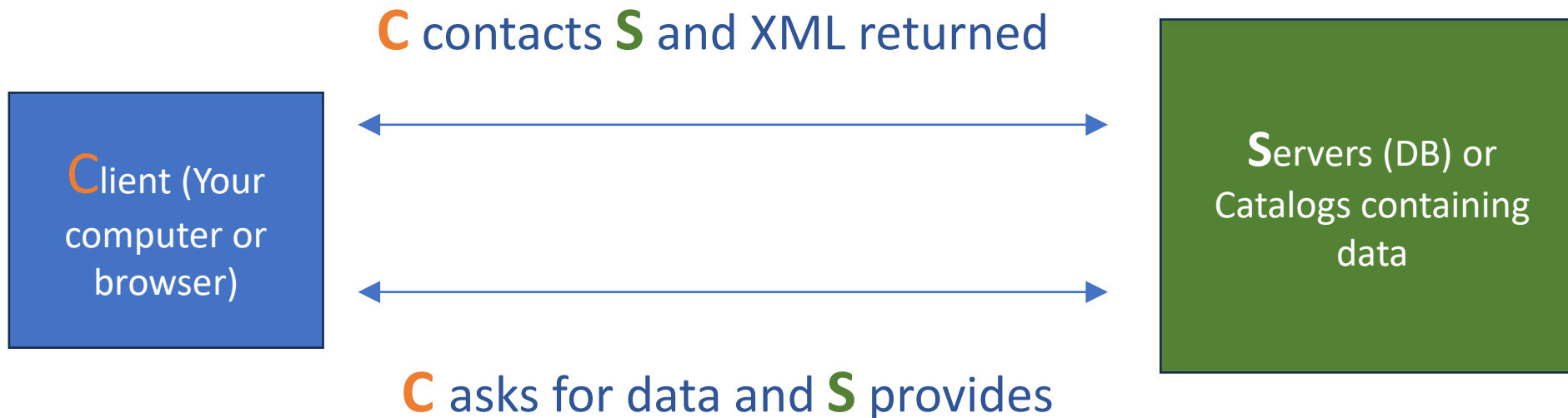
<https://dev.solita.fi/2018/01/05/gis-services.html>

## Web GIS Model



<https://sspinnovations.com/blog/web-gis-service-oriented-architecture-accelerating-change/>

# Basic Web Services Model: Client /Server



Web services work on a network and allow data to be exchanged. They use standards (OGC) to maximize interoperability.

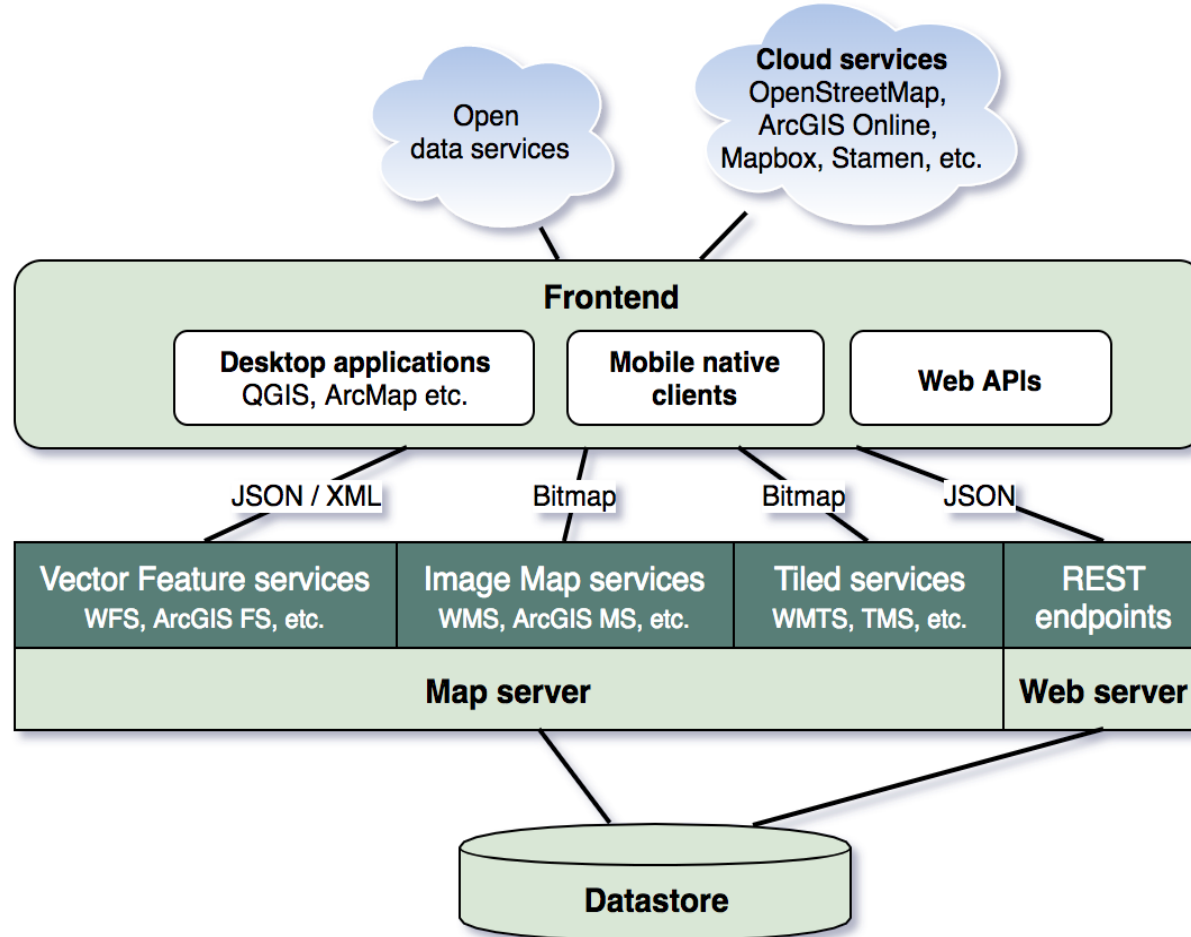
# What are Web Mapping Services?

- It is a simple web interface for requesting geo-registered map images from a GIS.
- Typically, a data set and area of interest are part of the request
- Geospatial data is returned.
- 2 camps
  - OGC and ESRI

<https://support.esri.com/en-us/knowledge-base/faq-what-is-the-difference-between-a-map-service-feature-000027304>

<https://www.ogc.org/standard/wms/>

# Web Services Architecture



Consumer / Client

Processing

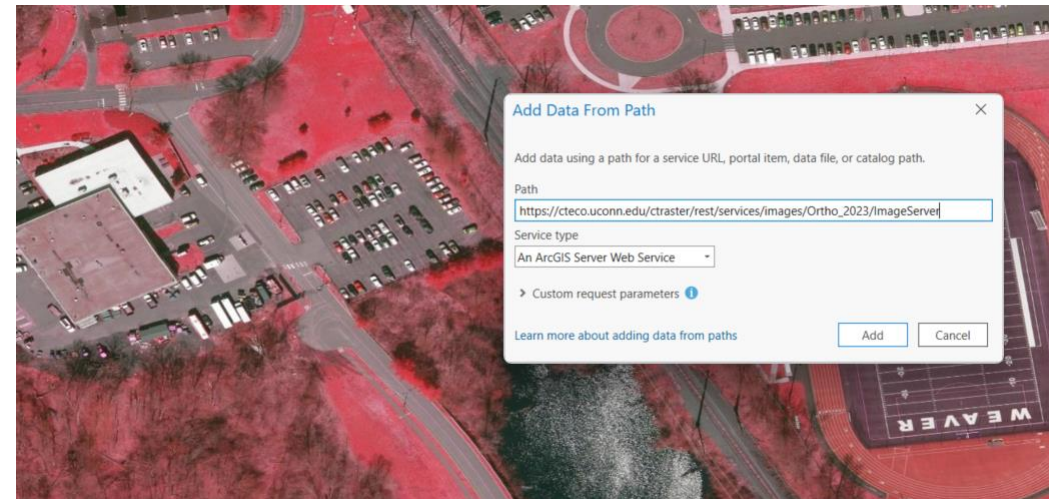
Storage / Server

# What are the Basic Geospatial Web Service Types?

- Basic types
  - Image-based map services
  - Feature-based services
  - Tile Map services

# Image Services

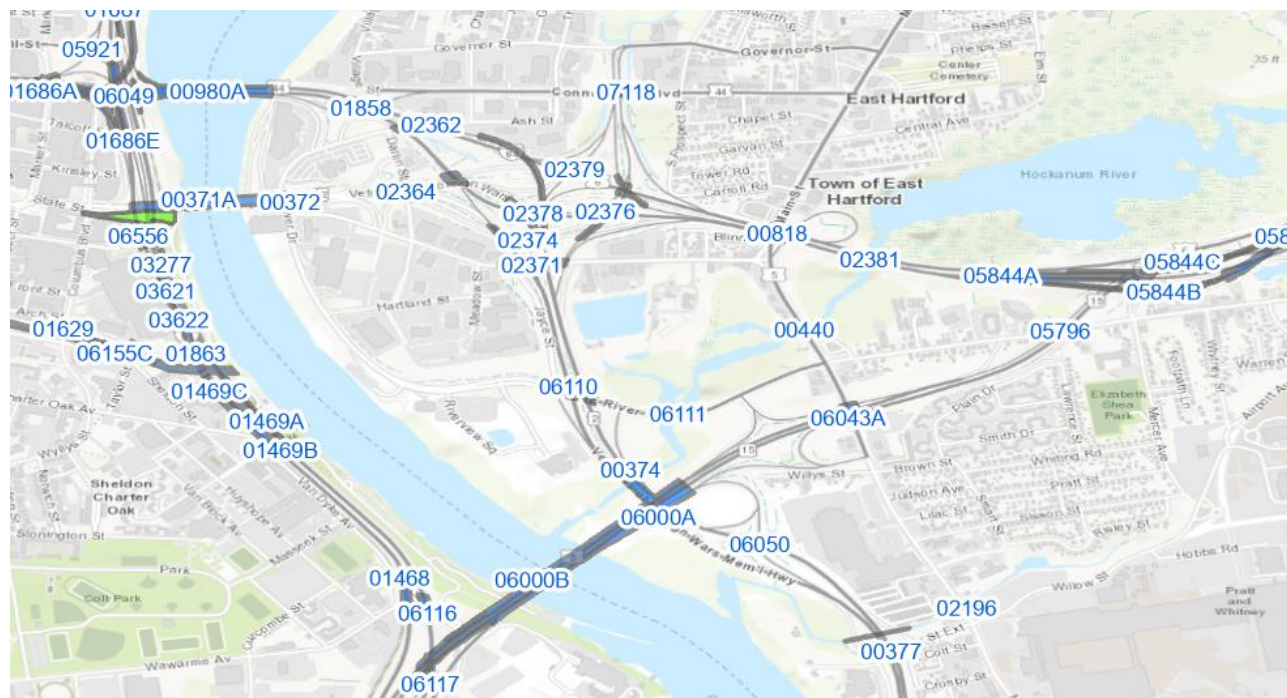
- Map services
  - WMS (OGS)
  - MapServices (ESRI Server)
    - Dynamic
- Use image formats to transfer data
- Visualization done by client
- RGB/NIR, Elevation



<https://www.marsbim.com/how-geospatial-engineering-services-drive-smarter-cities/>

# Feature-based services

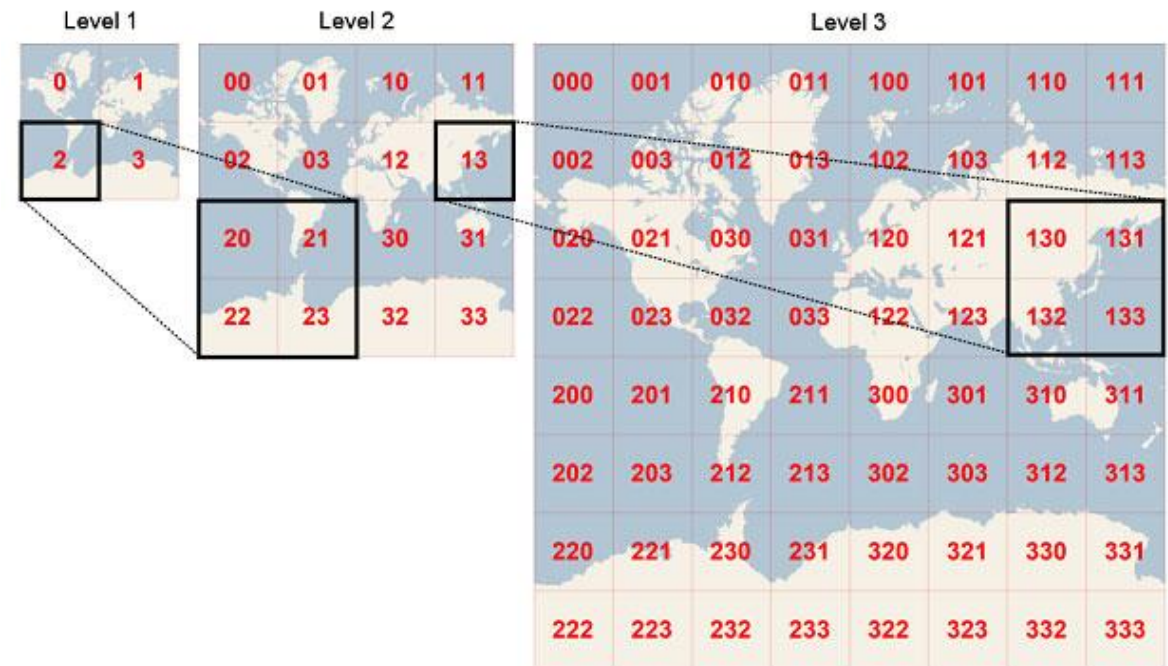
- Vector
  - WFS (OGS)
  - Feature service (ESRI)
- Geometric objects and control
- Visualization done by client
- Point, line, polygon data
  - Transportation data uses these formats extensively





# Tiled Map Services (aka. cached)

- Consists of map tiles in a cache
  - Typically 256x256 pixels
- Uses “Zoom” levels from low (level 1) to high (level 22)
- Handles large amounts of data like imagery
- **Very fast and scalable because “pre-cached”**
- Also vector tiles



<https://nextbillion.ai/glossary/what-is-a-map-tile>

<https://dev.solita.fi/2018/01/05/gis-services.html>

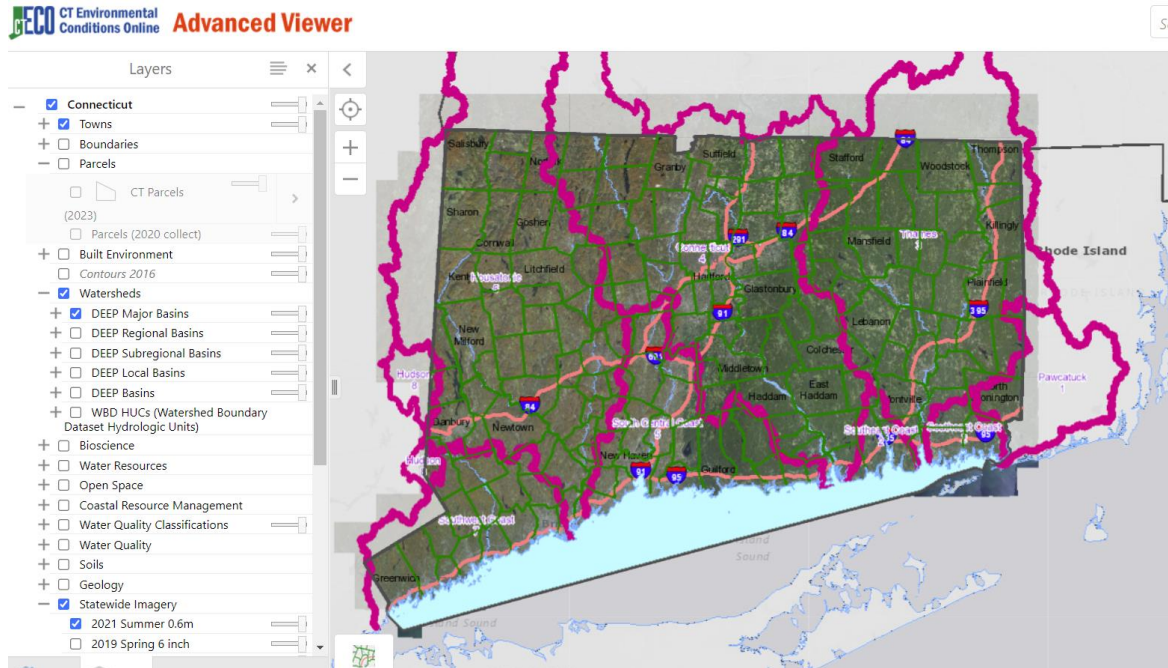
# Where to Find Services?

- CT ECO
  - Emily Wilson
- Methods
  - Viewers
  - **Services**
  - Downloads



Found at: <https://maps.cteco.uconn.edu/>

# Viewer v. Services v. Downloads (Demo)



### Aerial Imagery

Imagery - Spring Statewide

#### 2023 Spring 4 band, 3inch

**2023 Spring 4 band, 3inch**

This service does not have statewide coverage and contains the sections that have been delivered so far. Once the full state is received including the metadata, we will create the cached service and data download. Visit the [CT ECO blog](#) for updates.

**Server URL for dynamic image service:** [https://cteco.uconn.edu/ctraster/rest/services/Images/Ortho\\_2023/ImageServer](https://cteco.uconn.edu/ctraster/rest/services/Images/Ortho_2023/ImageServer)

**Server URL for cached service:** Coming soon

A PARTNERSHIP BETWEEN UCONN & CT DEEP  
 Connecticut Environmental Conditions Online

Home Maps Data Information

Map Overview

Map Catalog

Viewers

CT ECO on ArcGIS Online

A PARTNERSHIP BETWEEN UCONN & CT DEEP  
 Connecticut Environmental Conditions Online

Home Maps Data Information Features

Data Overview

Map and Image Services

# How to Consume the Imagery Services?



# Options for Viewing Imagery Service

- **ESRI** products and others
  - ArcGIS Online
  - ArcGIS Pro Desktop
  - Imagery Viewer Instant App/Experience Builder
- **AutoCAD and MicroStation**
  - ESRI plug-in
  - WMS
- **QGIS** (*free*)
  - Open-source desktop
  - Both WMS and Image Services
- **Leaflet and R/Python** (*free*)
  - Light scripting (10–15 lines of code)
  - WMS format or need ESRI plug in

*Limited free options to view web services*

# Viewing in AGOL

- **AGOL**
- Use the Map tab to open the Map Viewer
- Hit Add, have url ready
- Extensive instructions are available on CT ECO

**2023 Spring 4 band, 3Inch**

This service does not have statewide coverage and contains the sections that have been delivered so far. Once the full state is received including metadata, we will create the cached service and data download. Visit the [CT ECO blog](#) for updates.

**Server URL for dynamic image service:** [https://cteco.uconn.edu/ctraster/rest/services/images/Ortho\\_2023/ImageServer](https://cteco.uconn.edu/ctraster/rest/services/images/Ortho_2023/ImageServer)

**Server URL for cached service:** Coming soon

**Connect to Map and Image Services in ArcGIS Online**

ArcGIS Online is a cloud-based GIS by Esri. There are two kinds of accounts - free, public accounts and organizational accounts. An account is necessary in order to save content. The ArcGIS Online Map Viewer is the place to create maps which can then be shared as is, as a viewer, a story map and much more. One big benefit for CT ECO users is that ArcGIS online allows you to add different map and image services to the same map, along with your own GIS data or services from other places. It's a real map mashup!

**ArcGIS Online Map Viewer**

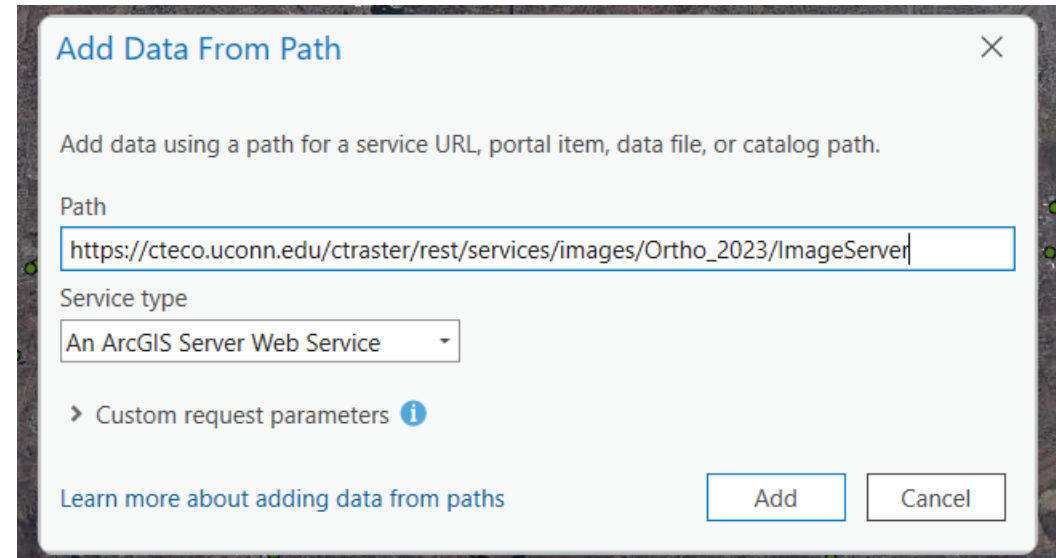
**Add a Map or Image Service to the ArcGIS Online Map Viewer**

- Add CT ECO Services that are registered with ArcGIS Online
- Add CT ECO Services via the Server Address
- Add an individual layer of a map service to ArcGIS Online

**Image Services in ArcGIS Online**

# Viewing in ArcGIS Pro

- Map tab > Add data > Add data from path
- Select service type and add



# ArcGIS Rest Services Directory

- From ArcGIS server
- Includes underlying metadata and additional services
- **WMS** url available for open-source tools and CAD packages
- Example:
  - `https://cteco.uconn.edu/ctraster/services/images/Ortho_2023/ImageServer/WMS`

Map and Image Services | Conn x images/Ortho\_2023 (ImageServ x +

cteco.uconn.edu/ctraster/rest/services/images/Ortho\_2023/ImageServer

Delivery Creating Georeferenc...

ArcGIS REST Services Directory

Home > services > images > Ortho\_2023 (ImageServer)

**JSON | SOAP | WMS**

**images/Ortho\_2023 (ImageServer)**

View In: [ArcGIS JavaScript](#) [ArcGIS Online Map Viewer](#) [ArcGIS Earth](#) [ArcMap](#)

View Footprint In: [ArcGIS Online Map Viewer](#)

Service Description: images/Ortho\_2023

Name: images/Ortho\_2023

Description:

Single Fused Map Cache: false

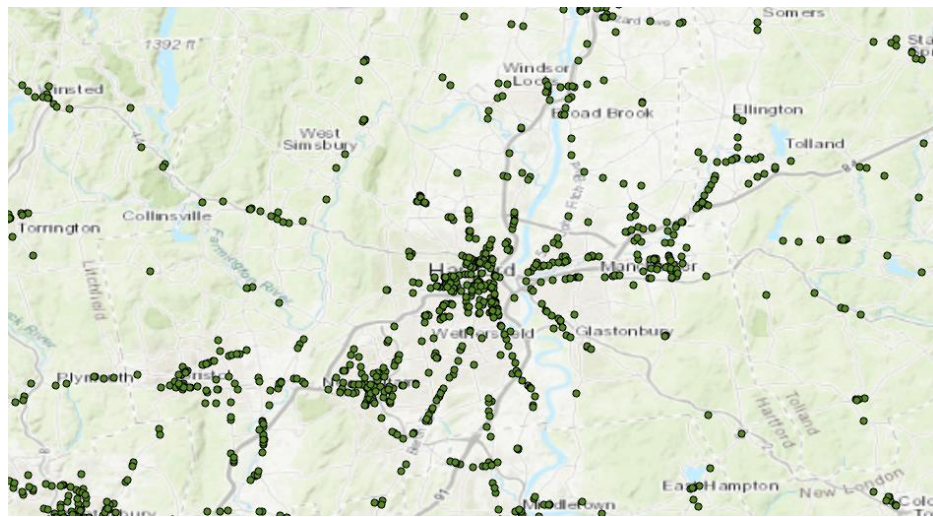
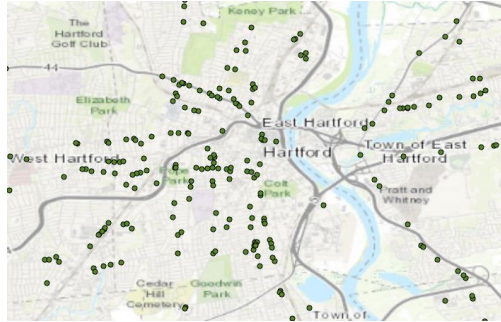
Extent:

XMin: -8208572.6952  
 YMin: 5008472.534071532  
 XMax: -7990330.048514716  
 YMax: 5169936.770799998  
 Spatial Reference: 102100 (3857)

Select URL



# Before and After



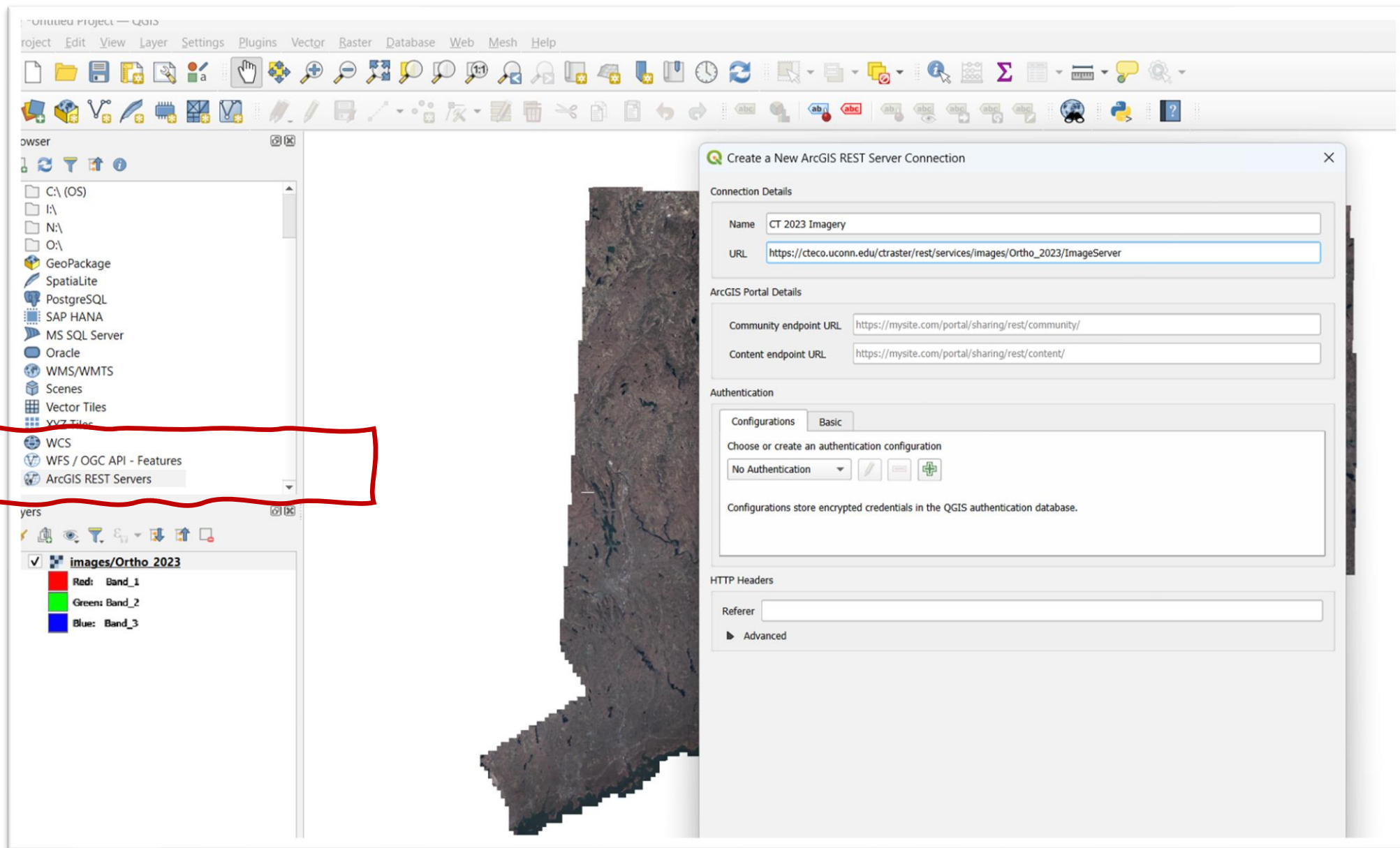
# QGIS and OGC Services

- Download stable enterprise version of QGIS

The screenshot shows the QGIS website's download page. The browser address bar displays 'qgis.org/download/'. The page features a navigation menu with 'Project', 'Community', and 'Resources' dropdowns, and a 'Download' button. A sidebar on the left lists 'Project', 'Community', 'Resources', 'Funding', 'Goodies', 'Download' (highlighted), and 'Archive'. The main content area is titled 'Download QGIS for your platform' and includes text about binary packages, the current version (3.38.2 'Grenoble'), and long-term builds (3.34.10 'Prizren'). It also lists supported operating systems: Windows, macOS, Linux, Android, and iOS. Two buttons are visible: 'Long Term Version for Windows (3.34 LTR)' and 'Latest Version for Windows (3.38)'. At the bottom, there is a button for 'OSGeo4W Network Installer'.

# QGIS

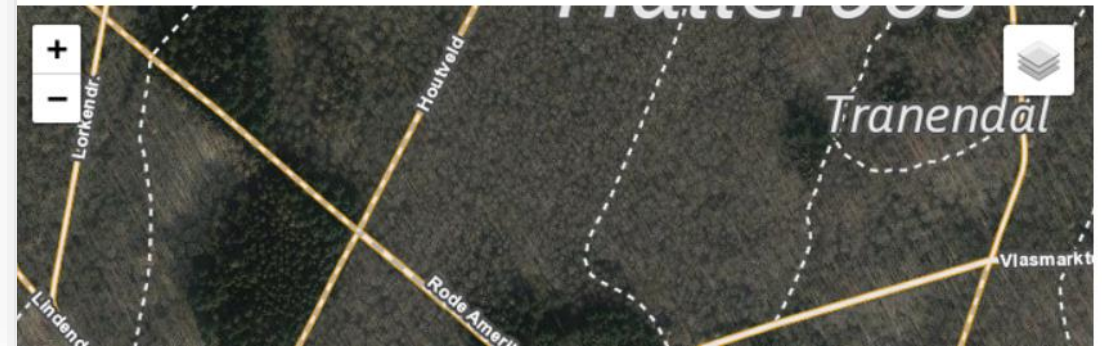
- Rt click ArcGIS Rest Servers in Browser panel
- Add URL
- Select layer panel



# R and Leaflet – viewing WMS services

- Can get WMS url from Rest Services Directory
- Small amount of R code will load up image service
- Use “addWMSTiles()” command

```
leaflet() %>%  
  setView(lng = 4.287638, lat = 50.703039, zoom = 16) %>%  
  addWMSTiles(  
    wms_ortho_be,  
    layers = "orthoimage_coverage",  
    group = "Orthophoto BE") %>%  
  addWMSTiles(  
    wms_cartoweb_be,  
    layers = "overlay",  
    options = WMSTileOptions(format = "image/png", transparent = TRUE),  
    group = "Topo BE"  
  ) %>%  
  addLayersControl(  
    baseGroups = "Orthophoto BE",  
    overlayGroups = "Topo BE"  
  )
```



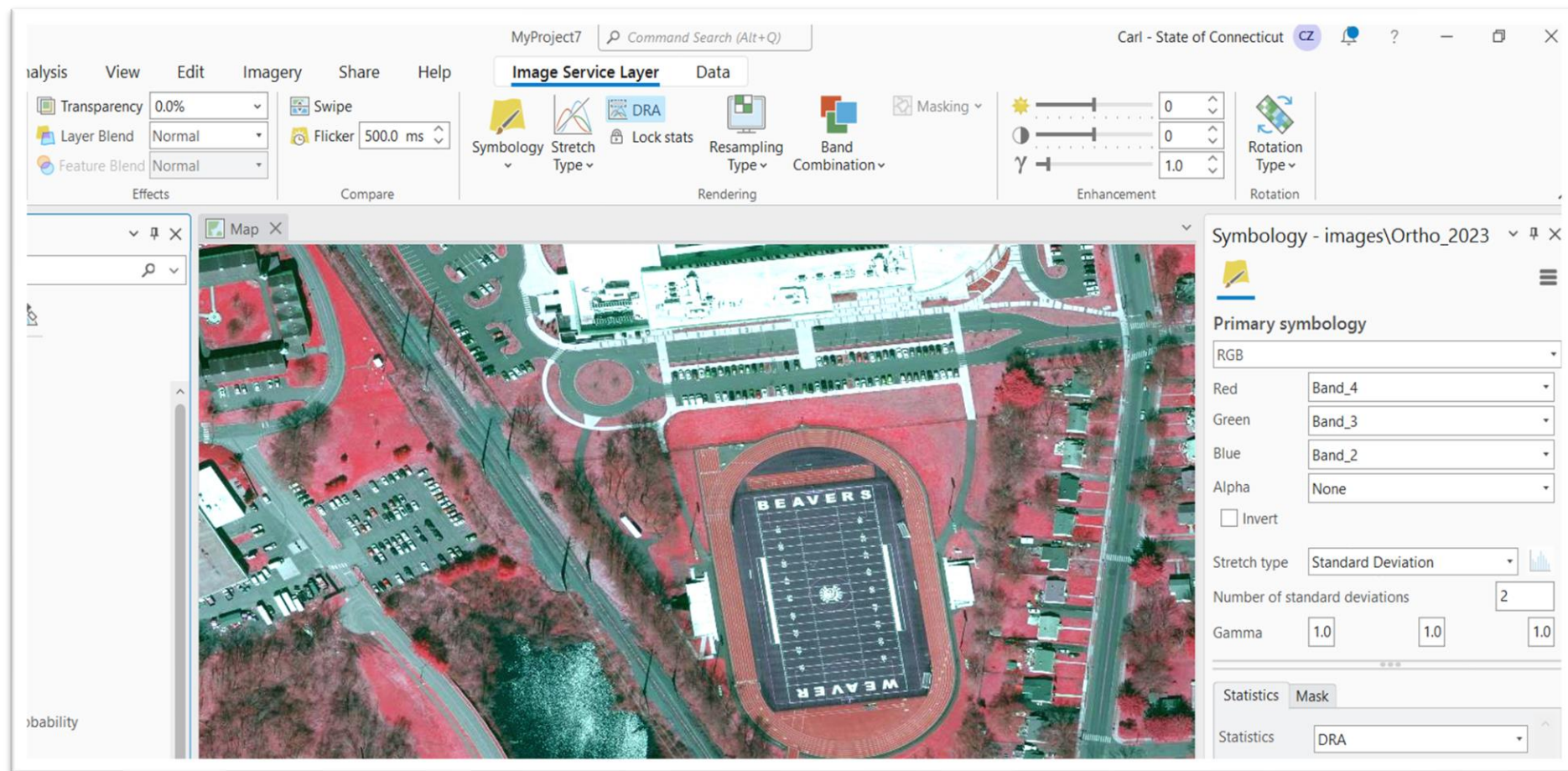
# What can we do with image services?



Integrate them  
Consume them

# Imagery Service Layer Tab (Pro)

- Use imagery services layer
- DRA—local adjustment
- Stretches
- Band combos



# Display Options in AGOL Map Viewer

- Similar functionality for image adjustment is available in Map Viewer
- Using image display allows for different patterns to be revealed within imagery

Details | Basemap

### Image Display

Set image display for: Ortho\_2023

**Renderer**  
User Defined Renderer

**RGB composite**  
4 3 3

**Image Enhancement**  
Symbology Type: Stretch  
Apply contrast enhancements to improve the image display.  
Stretch Type: Percent Clip

Trim extreme pixel values  
Exclude top: 0 %  
Exclude bottom: 0 %  
Gamma: 0.1 10

Dynamic range adjustment

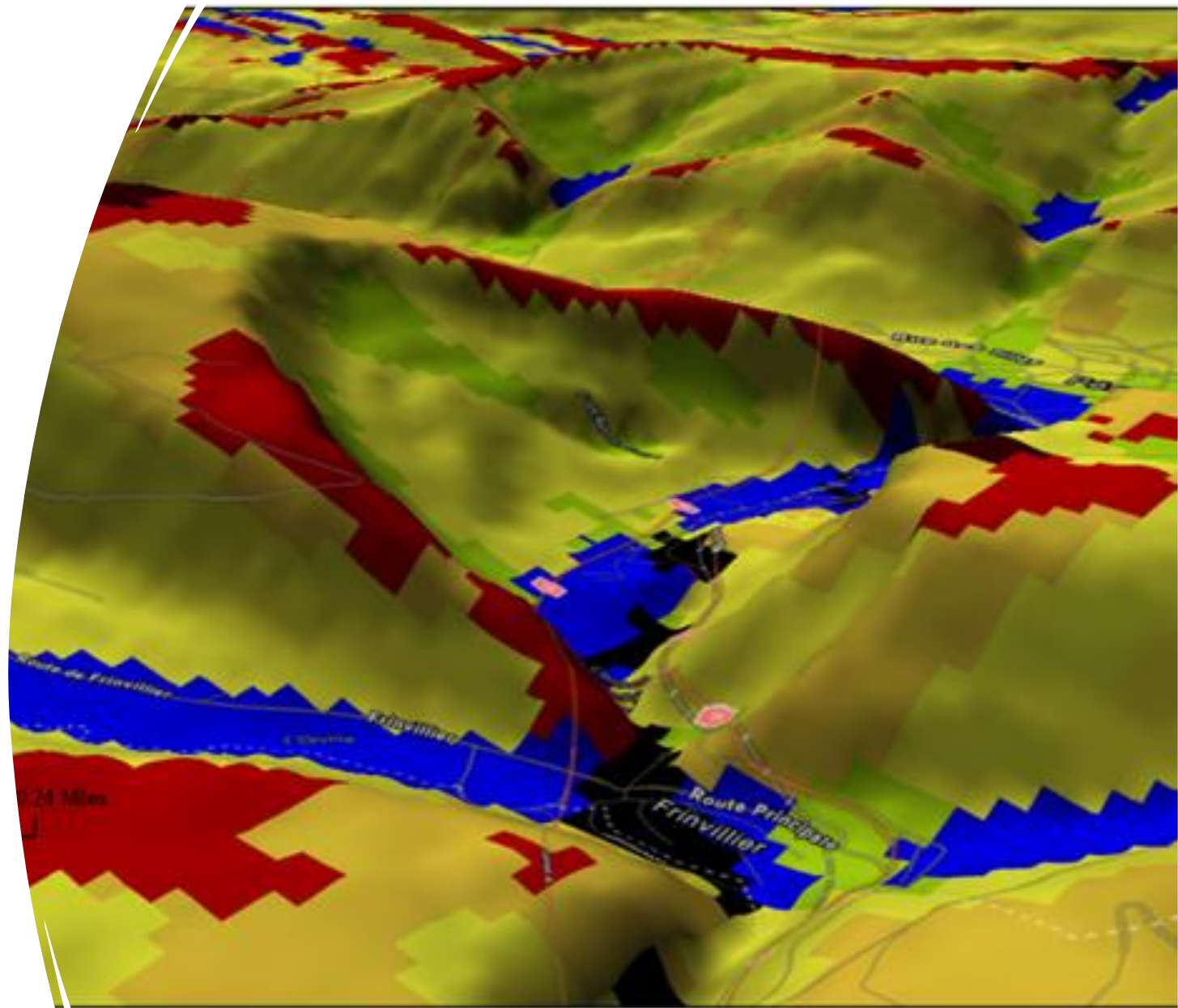
APPLY RESET CLOSE

Trust Center Legal Contact Esri Report Abuse

# Elevation data

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- A variety of downstream analyses are available
  - Hillshade and orientation tools
  - Hydro tools
  - Geomorphological and landscape tools
    - Whitebox tools





# DEMOS

- ArcGIS Pro and ImageService
- QGIS and ImageService or WMS

# References

- Programming Historian
  - Description of how to use Python and Leaflet to create a web service
  - <https://programminghistorian.org/en/lessons/mapping-with-python-leaflet>
- Python and Leaflet
  - Solanki, S. (2020, September 16). *ipyleaflet [Python] - Interactive Maps in Python based on leafletjs*. <https://coderzcolumn.com/tutorials/data-science/ipyleaflet-interactive-maps-in-python-based-on-leafletjs>
- Python and Essential packages
  - <https://forrest.nyc/the-37-geospatial-python-packages-you-definitely-need/>
- Using Web Services to work with Geodata in R
  - <https://journal.r-project.org/articles/RJ-2019-041/RJ-2019-041.pdf>
- Using WMS Services in R
  - [https://inbo.github.io/tutorials/tutorials/spatial\\_wms\\_services/](https://inbo.github.io/tutorials/tutorials/spatial_wms_services/)
- Adding AGOL Services
  - [https://maps.cteco.uconn.edu/help/connect\\_agol/](https://maps.cteco.uconn.edu/help/connect_agol/)
- ESRI Imagery Services
  - <https://enterprise.arcgis.com/en/server/latest/publish-services/windows/key-concepts-for-image-services.htm>
- Different services compared
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# Questions????

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